

SECTION 104

DISINFECTING AND PRESSURE TESTING

104-1 GENERAL

104-1.01 Description. - This work consists of disinfecting and pressure testing water systems. All incidental materials and equipment not mentioned in these specifications or the special provisions, or shown on the plans which may be necessary to complete testing and disinfecting, shall be furnished and installed as required to complete the work. The City will furnish all water required, and the Contractor shall provide for safe and adequate disposal of all water upon completion of testing and disinfecting.

104-2 DISINFECTING

104-2.01 Description. - This work consists of disinfecting water system initial installations and after repair. The work shall be accomplished in accordance with the provisions of AWWA Standard C651, as specified herein, the special provisions, and as directed by the Engineer.

104-2.02 Submittals. - At least 14 days prior to the start of disinfecting, a description of the method and procedure to be used shall be submitted.

104-2.03 Certification. -

104-2.03A Quality Requirements. - Liquid Chlorine and hypochlorites to be used as disinfectants shall conform to the physical requirements and shall be tested in accordance with the provisions of AWWA Standard B301 or B300.

104-2.03B Packing and Marking. - Liquid Chlorine and hypochlorites shall be sampled, inspected, packed and shipped in containers as specified in reference AWWA Standards.

104-2.03C Certificate of Compliance. - The manufacturer or producer of Liquid Chlorine or hypochlorites shall establish the necessary quality control and inspection practice to assure compliance with these specifications. The manufacturer or producer shall furnish a Certificate of Compliance, as specified in Section 6-1.07, "Certificates of Compliance" that all of the required tests have been made and the results thereof comply with the requirements of these specifications.

104-2.04 Materials. -

104-2.04A Classification. - Disinfectants of the chemical element chlorine are classified as to the form of the compound as follows:

- Liquid Chlorine - (gas atmosphere pressure)
- Calcium hypochlorite granules
- Sodium hypochlorite solutions
- Calcium hypochlorite tablets

104-2.04B Liquid Chlorine. - Liquid Chlorine shall be produced and supplied in accordance with the provisions of AWWA Standard B301.

104-2.04C Hypochlorites. - Hypochlorites for use as disinfectants shall conform to the provisions of AWWA Standard B300.

104-2.05 Flushing. - The main shall be flushed prior to disinfection, except when the tablet method is used. The flushing velocity should not be less than 2.5 feet/second. It must be understood that flushing removes only the lighter solids and cannot be relied upon to remove caked deposits or heavy materials allowed to get into the main during laying. The disposal site for flushing water shall be as directed by the Engineer. Flushing shall be done after the pressure test is made, for mains not connected to existing systems.

104-2.06 Chlorine Application. - Disinfection of all portions of newly installed water systems, including all valves and appurtenances, by application of chlorine shall be as specified herein.

104-2.06A Continuous Feed Method. - Water from the existing distribution system or other approved sources of supply shall be made to flow at a constant, measured rate into the newly-laid pipeline. The water shall receive a dose of chlorine, also fed at a constant, measured rate. The two rates shall be proportioned so that the chlorine concentration in the water in the pipe is maintained at a minimum of 50 mg/l available chlorine. To assure that this concentration is maintained, the chlorine residual should be measured at regular intervals in accordance with the procedures described in Section 104-2.07 "Chlorine Residual Measurement" or other approved methods.

Table 1 gives the amount of chlorine required to produce 50 mg/l concentration for each 100 feet of pipe of various diameters. Solutions of one percent chlorine may be prepared with sodium hypochlorite or calcium hypochlorite. The latter solution requires approximately one pound of calcium hypochlorite in 8.5 gallons of water.

During the application of the chlorine, valves shall be manipulated to prevent the treatment dosage from flowing back into the line supplying the water. Chlorine application shall not cease until the entire main is filled with the chlorine solution. The chlorinated water shall be retained in the main for at least 24 hours, during which time all valves and hydrants in the section treated shall be operated in order to disinfect the appurtenances. At the end of this 24 hour period, the treated water shall contain no less than 25 mg/l chlorine throughout the length of the main.

Table 1
REQUIRED CHLORINE
50 Mg/l Concentration

Pipe Size In.	100 percent Chlorine lb.	1 percent Chlorine Solutions gal.
4	0.027	0.33
6	0.061	0.73
8	0.108	1.30
10	0.170	2.04
12	0.240	2.88

104-2.06B Slug Method. - This method is suitable for use with mains of large diameter for which, because of the volumes of water involved, the continuous feed method is not practical.

Water from the existing distribution system or other approved source of supply shall be made to flow at a constant, measured rate into the newly laid pipeline. The water shall receive a dose of chlorine, also fed at a constant, measured rate. The two rates shall be proportioned so that the concentration in the water entering the pipeline is maintained at no less than 300 mg/l. The chlorine shall be applied continuously and for a sufficient period to develop a solid column or "slug" of chlorinated water that will, as it passes along the line, expose all interior surfaces to a concentration of at least 300 mg/l for at least 3 hours. The application shall be checked at a tap near the upstream end of the line by chlorine residual measurements made according to the procedures described in Section 104-2.07 "Chlorine Residual Measurement."

As the chlorinated water flows past tees and crosses, related valves and hydrants shall be operated so as to disinfect appurtenances.

104-2.06C Tablet Method. - Tablet disinfection is best suited to short extensions (up to 2,500 feet) and smaller diameter mains (up to 12 inches). Because the preliminary flushing step must be eliminated, this method shall be used only when scrupulous cleanliness has been exercised in laying of the pipe. Tablet method shall not be used if trench water or foreign material has entered the main or if the water is below 5 °C (41 °F).

104-2.06C(1) Placement of Tablets. - Tablets are placed in each section of pipe and also in hydrants, hydrant branches, and other appurtenances. They shall be attached by an adhesive, except for the tablets placed in hydrants and in the joints between the pipe sections. All the tablets within the main must be at the top of the main. If the tablets are fastened before the pipe section is placed in the trench, their position should be marked on the section to assure that there will be no rotation. In placing tablets in joints, they are either crushed and placed on the inside annular space, or, if the type of assembly does not permit, they are rubbed like chalk on the butt ends of the sections to coat them with calcium hypochlorite.

The adhesive may be any inert substance, approved by the Engineer. There shall be no adhesive on the tablet except on the broad side next to the surface to which the tablet is attached.

The number of Hypochlorite Tablets required for a minimum concentration of 50 mg/l of available chlorine in water is as indicated in Table 2. The number of tablets is based on 3-3/4 grams of available chlorine per tablet.

Table 2
HYPOCHLORITE TABLETS

Length of Section Feet	Diameter of Pipe Inches						
	2	4	6	8	10	12	18
13 or less	1	1	2	2	3	5	12
18	1	1	2	3	5	6	15
20	1	1	2	3	5	7	16
30	1	2	3	5	7	10	24
40	1	2	4	6	9	14	30

104-2.06(C) Filling and Contact. - When installation has been completed, the main shall be filled with water at a velocity of less than one foot/second. This water shall remain in the pipe for at least 24 hours.

Valves shall be manipulated so that the strong chlorine solution in the line being treated will not flow back into the line supplying the water.

104-2.07 Chlorine Residual Measurement. - The chlorine residual may be measured by the drop dilution method. The drop dilution method of approximating total residual chlorine, as specified herein, is suitable for concentrations above 10 mg/l. The procedure is taken from AWWA Standard M12 "Simplified Procedures for Water Examination."

104-2.07A Apparatus. -

- (1) A graduated cylinder for measuring distilled water
- (2) An automatic or safety pipet
- (3) A dropping pipet that delivers a one milliliter sample is 20 drops. This pipet is for measuring the water sample and should not be used for any other purpose.
- (4) A comparator kit containing a suitable range of standards.

104-2.07B Procedures. -

- (1) Ascertain the volume of the comparator cell and using an automatic or safety pipet add 0.5 milliliters of orthotolidine for each 9.5 milliliters of distilled water to be added.
- (2) Using a graduated cylinder, add a measured volume of distilled water.
- (3) With the dropping pipet, add the water sample a drop at a time, allowing mixing, until a yellow color is formed that matches one of the color standards.
- (4) Record the total number of drops used and the final chlorine value obtained.

- (5) Calculate the milligrams per liter residual chlorine as follows:
- (a) Multiply by 20 the number of milliliters of distilled water used in step (2).
 - (b) Multiply this product by the final chlorine value in milligrams per liter recorded in step (4).
 - (c) Divide the product found in step (b) by the total number of drops of water sample recorded in step (4).

104-2.08 Final Flushing. - After the applicable retention period, the heavily chlorinated water shall be flushed from the main until the chlorine concentration in the water leaving the main is no higher than that generally prevailing in the system, or less than one mg/l. Chlorine residual determination shall be made to ascertain that the heavily chlorinated water has been removed from the pipeline.

104-2.09 Bacteriologic Tests. - After final flushing, and before the water main is pressure tested, a sample or samples shall be collected in locations specified by the Engineer and tested for bacteriologic quality and shall show the absence of coliform organisms.

Samples for bacteriologic analysis shall be collected in sterile bottles treated with sodium thiosulphate. No hose or fire hydrant shall be used in collection of samples. Samples shall be tested in accordance with, and shall conform to the requirements of the Santa Clara County Health Department, and/or the State of California Department of Public Health. Testing shall be performed at a Certified Laboratory approved by the City and at no cost to the City.

If the initial disinfection fails to produce satisfactory samples, disinfection shall be repeated until satisfactory samples have been obtained. The tablet method cannot be used in these subsequent disinfections. When the samples are satisfactory, the main may be placed in service.

104-2.10 Emergency Disinfection Treatment. - The procedures outlined in this section apply primarily when mains are wholly or partially dewatered. Leaks or breaks that are repaired with clamping devices while the mains remain full of water under pressure present little danger of contamination and require no disinfection.

104-2.10A Trench Treatment. - When an existing main is opened, either by accident or by design, the excavation will likely be wet and badly contaminated from nearby sewers. Liberal quantities of hypochlorite, in tablet form, applied to open trench areas will lessen the danger from such pollution. Tablets have the advantage in such a situation because they dissolve slowly and continue to release hypochlorite as water is pumped from the excavation.

104-2.10B Main Disinfection. - The following procedure is considered as a minimum that may be used.

104-2.10B(1) Swabbing with Hypochlorite Solution. - The interior of all pipe and fittings used in making the repair (particularly couplings and tapping sleeves) shall be swabbed with a 5 percent hypochlorite solution (commercial bleach) before they are installed.

104-2.10B(2) Flushing. - Thorough flushing is the most practical means of removing contamination introduced during repairs. If valving and hydrant locations permit, flushing from both directions is recommended. Flushing shall be started as soon as the repairs are completed and continued until discolored water is eliminated.

104-2.10B(3) Slug Method. - Where practicable, in addition to the procedures above, a section of main in which the break is located shall be isolated, all service connections shut off, and the section flushed and chlorinated as described in this section, except that the dose may be increased to as much as 500 mg/l, and the contact time reduced to as little as 1/2 hour. After chlorination, flushing shall be resumed and continued until discolored water is eliminated.

104-2.10B(4) Sampling. - Bacteriologic samples shall be taken after repairs to provide a record by which the effectiveness of the procedures used can be determined. If the direction of flow is unknown, samples shall be taken on each side of the main break.

104-2.11 Measurement and Payment. - Separate payment will not be made for disinfecting water systems. Full compensation for such disinfecting shall be considered as included in the various contract items of work involved.

104-3 HYDROSTATIC TESTING

104-3.01 Description. - This work shall consist of hydrostatically testing newly installed water systems for leakage and soundness and the furnishing of all necessary materials and equipment required therewith. All water mains and service connection work shall be subjected to both pressure and leakage tests.

The procedure as specified herein is based on the assumption that the pressure and leakage test will be performed at the same time. Should the Contractor desire, separate tests may be made. If separate tests are made, the pressure test will be performed first.

In as much as trenches have to be backfilled immediately after the pipe has been laid for safety and other reasons, pressure and leakage tests shall be made after backfilling has been completed but before placement of permanent paving.

When the newly installed water system is connected to existing mains, bacteriological clearance shall be obtained before conducting pressure and leakage tests.

Each valved section of line shall be brought to test pressure of 200 psi unless otherwise specified and maintained for one hour minimum, using either pneumatic or hydraulic means to maintain the pressure. At the end of the test period, the volume of water pumped into the line shall be measured and recorded as the leakage for that test section.

For acceptance of the water system, each test section shall not exceed the allowable leakage as determined in accordance with the following formula:

$$L = SD \times \sqrt{P} \div 133, 200$$

in which L is the maximum acceptable leakage (Gallons/Hr.);
S is the reach or length of the test section in feet;
D is the diameter of pipe in inches; and
P is the test pressure

If the leakage rate exceeds the allowable limit, the pressure shall be maintained for a sufficient length of time as necessary to locate the leak or leaks. After the leak or leaks are corrected to the satisfaction of the Engineer, the hydrostatic pressure and leakage test shall be repeated.

104-3.02 Test Report. - The Contractor shall maintain a record of all hydrostatic tests made, and shall submit to the Engineer a written report of the results of such tests. The report shall include: (1) date and time of test, (2) description of pipe section tested, (3) average pressure used, (4) duration of test, (5) amount of measured leakage, and (6) location of leaks, if any, and corrective action taken. The Engineer shall monitor all tests and the test report shall be signed by the Contractor and the Engineer.

104-3.03 Measurement and Payment. - Separate payment will not be made for testing water systems. Full compensation for such testing shall be considered as included in the various contract items of work involved.